CLAIMS

1. A method of etching silicon anisotropically, in which a silicon substrate (2) protected in part by a mask (2c) is subjected to an alternating succession of attack steps (a) using a plasma of etching gas to make cavities (2b) in zones of the substrate that are not protected by the mask (2c), and passivation steps (b) using a plasma of passivation gas for depositing protective polymer (2f) on the walls of the cavities (2b) that result from the attack steps,

the method being characterized in that it further comprises selective depassivation pulse steps (c) in which the protective polymer deposit (2f) is subjected to the action of a plasma of cleaning gas that removes the protective polymer (2f) from the bottom zones (2g) of the cavities (2b) and that is more effective than the etching gas.

2. A method according to claim 1, characterized in that it includes a selective depassivation pulse step (c) after each passivation step (b).

3. A method according to claim 2, characterized in that each selective depassivation pulse step (c) does not overlap the preceding passivation step (b), and does not overlap the following attack step (d).

4. A method according to any one of claims 1 to 3, characterized in that the etching gas is a fluorine gas such as SF_6, CF_4, or NF_3.

5. A method according to any one of claims 1 to 4, characterized in that the passivation gas is a fluorocarbon gas such as CHF_3, C_2F_6, C_2F_4, or C_4F_8.

6. A method according to any one of claims 1 to 5, characterized in that the cleaning gas contains oxygen.

7. A method according to claim 6, characterized in that the cleaning gas comprises at least one of the following gases: O_2, SO_2, CO, CO_2, NO, NO_2, N_2O.

8. A method according to any one of claims 1 to 7, characterized in that during the selective depassivation pulse step (c), the substrate (2) is biased so as to attack the ions of the plasma.

9. A method according to claim 8, characterized in that the substrate (2) is biased by a voltage close to the voltage used during the attack step (a), typically in the range 20 V to 100 V, advantageously in the range 20 V to 80 V.

10. A method according to claim 8 or claim 9, characterized in that the bias voltage applied to the substrate (2) is increased progressively from one depassivation step to another during the process of etching a substrate (2).

11. A method according to any one of claims 8 to 10, characterized in that during the selective depassivation pulse step (c), the pressure of the atmosphere (5) surrounding the substrate (2) lies in the range 0.5 Pa to 10 Pa, and preferably in the range 2 Pa to 5 Pa.

12. A method according to any one of claims 1 to 11, characterized in that the duration of the selected depassivation steps (c) is selected to be just sufficient to ensure effective cleaning of the bottom zones (2g) of the cavities (2b).

13. A method according to any one of claims 1 to 12, characterized in that the duration of the selected

depassivation pulse step (c) is determined as a function of the duration of the preceding passivation steps (b).

14. A method according to any one of claims 1 to 13, characterized in that the duration of the selected depassivation pulse step (c) increases from one depassivation step to another during the process of etching a substrate (2).

15. Apparatus for anisotropically etching silicon substrates (2), by implementing a method according to any one of claims 1 to 4, the apparatus comprising:

· a gastight enclosure (1) shaped to receive and contain a substrate (2) for etching;

· means (6, 7) for creating and maintaining a suitable vacuum in the enclosure (1);

· gas injection means (13) for selectively injecting into the enclosure (1) etching gas, passivation gas, and cleaning gas for programmed durations and at programmed flow rates;

· means (8) for generating a plasma (9) in the enclosure (1) facing the surface (2a) of the substrate (2) that is to be etched;

· means (4) for biasing the substrate (2); and

· control means (22) for controlling the gas injection means (13) to perform the successive etching, passivation, and depassivation steps.

16. A silicon-based component having micro-relief (2b) presenting an aspect ratio greater than 30, made using a method according to any one of claims 1 to 14.